Engineering Tripos Part IIB, 4I11: Advanced Fission and Fusion System, 2021-22

Module Leader

Dr E Shwageraus [1]

Lecturers

Dr N Read [2]

Timing and Structure

Lent Term. 16 lectures, 4 examples papers, 2 examples classes in support of coursework. Assessment: 100% coursework

Prerequisites

4M16

Aims

The aims of the course are to:

- provide an understanding of advanced systems, why they are being pursued, what their advantages are and their difficulties in becoming commercially viable designs.

Content

Further aims:

- What are the factors that are driving the development of advanced systems?
- Overview of fast reactor development & Generation IV reactor systems, including accelerator driven sub-critical reactors;
- Introduce the principles of fusion energy physics and the current status of research;
- Explain how the principles of fusion energy are to be applied for the design of future fusion energy systems;
- Re-cycle fuel studies, including reprocessing and re-fabrication;
- Status, issues and what would be needed to bring advanced reactor systems to a commercial standard with safety and economics as good as current Generation III+ designs

Fission Systems

- Design objectives, drivers & alternatives (2L)
- Advanced thermal systems – example high temperature gas-cooled reactor (2L)
- Fast spectrum reactor systems – including external lecturer A Judd (4L)
- Transmutation and advanced fuel cycles (2L)

Fusion Systems

Introduction & Physics of Fusion Systems - CCFE (2L)

- Fusion reactions: cross-sections and reactivity
- Magnetic and inertial approaches to fusion
- Equilibrium, transport, instabilities and power balance

Physics & Materials - CCFE (2L)

- Heating systems and current drive
- Layout of a fusion power plant
- Fusion reactor components and materials requirements

Performance Safety and Design - CCFE (2L)

- Safety of a fusion reactor
- Radiological hazards and waste products
- Fusion in the market and timescale to commercial fusion plant
- Designing a fusion power plant

Examples papers

- Thermal Reactor Systems (High Temperature Gas-cooled Reactors)

- Fast Reactors

- Fusion: Plasma Physics and Reactor Engineering

Coursework

Coursework #1 Group project (3-4 students) researching into a particular advanced reactor design. This part will be assessed by a group presentation to the rest of the class. The presentations will be scheduled at a convenient time outside the normal lectures schedule. <u>Learning objective:</u> • Research in depth one of the advanced reactor systems • Become familiar with a broad range of advanced systems, their strengths and weaknesses
Coursework #2 Fast reactor transient analysis using provided computer models. This part of the coursework will be preceded by an examples class, where these models will be introduced and demonstrated <u>Learning objective:</u> • Understand fundamentals of fast reactor transient behaviour and safety
Coursework #3

Problem set on advanced fission reactors, plasma physics and fusion technology.

Learning objective:

- Understand fundamentals of fusion power systems physics and engineering

Booklists

Please refer to the Booklist for Part IIB Courses for references to this module, this can be found on the associated Moodle course.

Examination Guidelines

Please refer to Form & conduct of the examinations [3].

Last modified: 27/09/2021 15:11

Source URL (modified on 27-09-21): https://teaching26-27.eng.cam.ac.uk/content/engineering-tripos-part-iib-4i11-advanced-fission-and-fusion-system-2021-22

Links
[1] mailto:es607@cam.ac.uk
[2] mailto:nr438@cam.ac.uk
[3] https://teaching26-27.eng.cam.ac.uk/content/form-conduct-examinations